Space Weather Technical Forecast

Issued on Friday, 07 July 2023 at 01:24 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of R1/R2 radio blackouts. G1/Minor Storm to G2/Moderate Storm possible today with CME arrival.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Moderate, with only one M-class flare, an M1.0 at 05/1858UTC most likely from AR3354, which is now beyond the northwest limb. There are eight numbered sunspot regions on the visible disc. AR3361 and AR3359 have evolved notably through the last 24 hours, increasing in both length and complexity, and are respectively classified as Eai/beta-gamma and Dai/beta-gamma. Previous region AR3354 was active, despite having rotated onto the farside. AR3363 is the largest region on the visible disc, but is still emerging from the southeast limb. A weak CME appears to have emanated from the southeast quadrant around 06/0600UTC, and is unlikely to be Earth directed.

Solar Wind / Geomagnetic Activity: The solar wind as observed at L1, was predominantly at slightly elevated levels, with a gradually increasing trend. After starting the period around 420 km/s the solar wind ended the day close to 500 km/s. Total magnetic field strength remained at moderate levels, between 8-12 nT. The north-south component, Bz, has varied weakly through much of the period, and was often negative, with a negative peak of -10nT at 06/0953UTC. The phi angle was positive (towards the Sun) throughout. Geomagnetic activity has been Quiet to Unsettled Kp 2-3). The solar wind parameters indicate a possible weak connection to coronal hole 20, which was previously discernible on imagery.

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV), as observed by GOES16, was at background levels. High energy electron flux (greater than 2MeV), as observed by GOES16, remained at moderate levels, with a peak of 636 pfu at 06/1720 UTC. The 24-hour integrated fluence has been on a declining trend, falling below the Active (1e8 integrated pfu) threshold at 06/1200 UTC. A fluence of 1.612e7 pfu was recorded at 07/0000UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Low to Moderate solar activity is forecast, with a chance of M-class flares, but a decreasing risk of X-class flares from a region which has rotated off the solar disc. A number of regions rotating onto the visible disc, through the forecast period, may increase activity.

Solar Wind / Geomagnetic Activity: A partial halo CME from a filament eruption near AR3359 on 04 July is forecast to arrive at Earth today, most likely this morning, with a speed of around 550km/s. Without a CME arrival solar wind speeds would be expected to increase to 550-600km/s later today due to a connection to coronal hole 22. Therefore the solar wind is expected to increase from slightly elevated levels to become elevated or possibly strong through today, then decline to slightly elevated levels during day 4.

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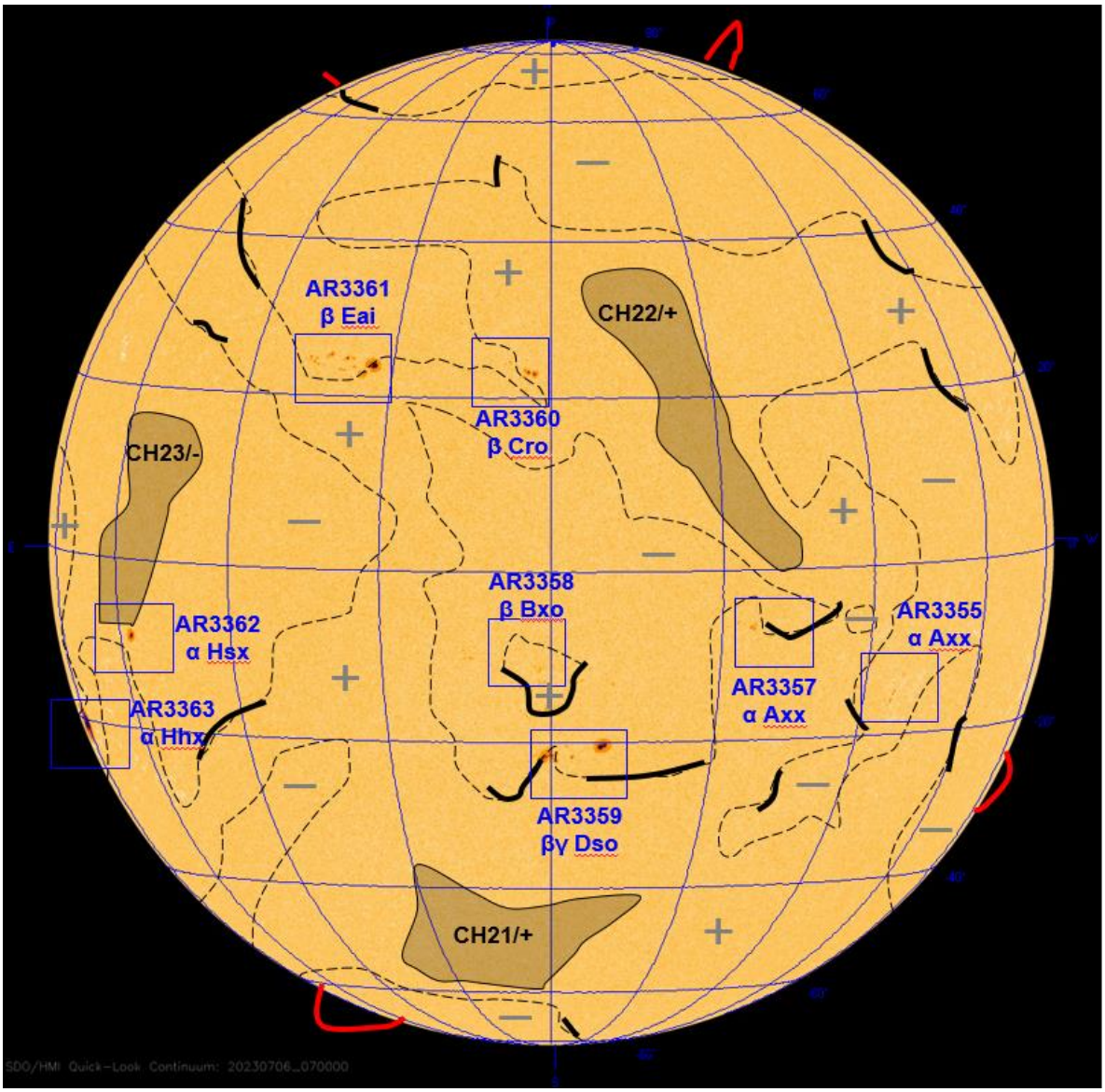
Geomagnetic activity is forecast to increase from Quiet to Unsettled (Kp 2-3), to become Unsettled to Active (Kp 3-4) with a risk of G1/Minor or G2/Moderate (Kp 6 or 7) storms today and tomorrow due to the possible CME arrival, and to a lesser extend coronal hole influence. Through day 4 (10th) Quiet to Unsettled (Kp 1-3) conditions are expected.

Energetic Particles / Solar Radiation: The high energy (greater than 10MeV) proton flux has a slight chance of reaching the S1/Minor Storm threshold through the period. High energy electron flux (greater than 2MeV) is expected to remain at background to moderate levels today and tomorrow due to the geomagnetic enhancements, then from day 3 (9th) a steady increase in diurnal peaks is likely, probably breaching the High threshold (1000 pfu). Electron fluence is expected to continue to decline at first, but later in the forecast period show an increase as a response to the HSS from CH22. However, the fluence is still likely to remain below the Active threshold (1e8 integrated flux) throughout the period.

Figure 1. Solar Analysis Valid 06/1900 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

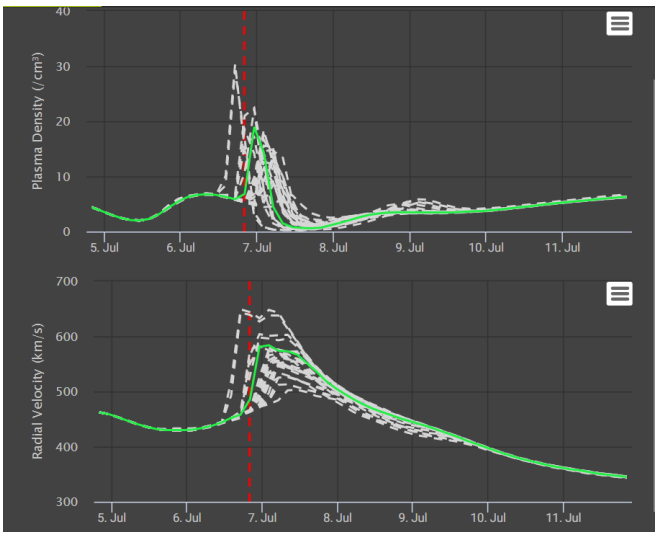
A partial halo CME which left the Sun on 04 July, is forecast to arrive at Earth today, but with low confidence in the actual arrival time, although currently a morning arrival is considered most likely. In addition to the CME coronal hole 22 is due to connect with the Earth today, this most likely to occur late today, Therefore the solar wind is expected to increase from slightly elevated levels to become elevated or possibly strong through today, then decline to slightly elevated levels during day 4. Geomagnetic activity is forecast to increase from Quiet to Unsettled (Kp 2-3), to become Unsettled to Active (Kp 3-4) with a risk of G1/Minor or G2/Moderate (Kp 6 or 7) storms today and tomorrow due to the possible CME arrival, and to a lesser extend coronal hole influence. Through day 4 (10th) Quiet to Unsettled (Kp 1-3) conditions are expected.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	60	40	10	5
Strong	G3	No	10	5	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
04/1000	Partial halo	Filament eruption	SE quadrant	550km/s	06/0000UTC	G1 or G2 possible

Figure 2: MOSWOC Enlil ensembles.



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Radio Blackouts - X-Ray Flares:

Solar activity has been Moderate, with an M1.0 flare observed from the now departed AR3354 at 06/1049 UTC. There are 10 sunspot regions on the visible disc, 8 of which are numbered. Of these AR3359 and AR3361 are the most complex regions, but the largest region is AR3363 which has rotated onto the visible side of the Sun during the last 24 hours. There are two new, small and simple regions, one in the northeast and one in south-centre disc. These regions, along with most of the numbered regions, have shown little change over the past 24 hours. Only AR3355 and AR3358 have shown a very slight increase in spot number and size or complexity. Low to Moderate activity is likely flares with a slight chance of an X-flare.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	20	20	20	20
Very Active	R3 to R5 X Class	No	5	5	5	5

Solar Radiation Storms - (High Energy Protons):

The high energy (greater than 10MeV) proton flux, as observed by GOES16, is currently at background levels. There is a slight chance of S1/Minor storm levels being reached through this period, as the current regions on the disk do not pose a significant risk.

Radiation Storms	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	5	5	5	1
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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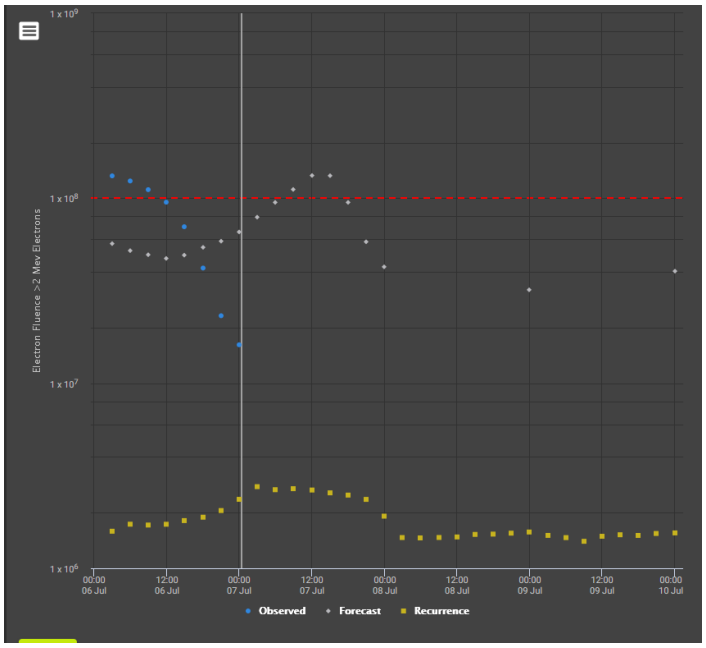
High Energy Electrons Event (≥ 2MeV):

High energy electron flux (greater than 2MeV) is expected to remain at background to moderate levels today and tomorrow due to the geomagnetic enhancements, then from day 3 (9th) a steady increase in diurnal peaks is likely, probably breaching the High threshold (1000 pfu). Electron fluence is expected to continue to decline at first, but later in the forecast period show an increase as a response to the HSS from CH22. However, the fluence is still likely to remain below the Active threshold (1e8 integrated flux) throughout the period.

The Met Office REFM model is considered to be offering poor advice, with the fluence remaining below the Active threshold preferred for day 1.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	Yes	20	20	30	50
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 3: MOSWOC REFM model.



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